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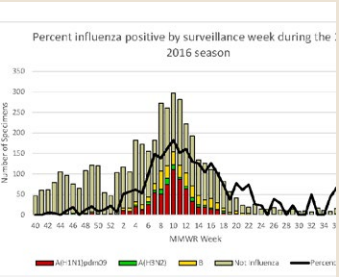

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Incident Diagnoses of Non-Melanoma Skin Cancer, Active Component, U.S. Armed Forces, 2005–2014

Terrence Lee, PhD, MPH; Stephen B. Taubman, PhD; Valerie F. Williams, MA, MS

From 1 January 2005 through 31 December 2014, a total of 8,819 incident diagnoses of non-melanoma skin cancer (NMSC) (incidence rate 64.6 cases per 100,000 person-years [p-yrs]) were documented in the health records of 6,670 active component service members. During the surveillance period, there was a very slight decrease in the annual crude incidence rates of NMSC; rates of NMSC peaked in 2007 (68.3 cases per 100,000 p-yrs) and were at their lowest in 2013 (60.4 cases per 100,000 p-yrs). Increasing age was associated with increased risk of NMSC. White, non-Hispanic service members had a much higher rate of NMSC compared to those of other race/ethnicity groups. Female service members had a slightly lower rate of NMSC compared to male service members. Rates were elevated for officers and higher ranks compared to enlisted and lower ranks and were highest for Air Force members and lowest for Marine Corps members. Rates were highest for service members associated with air travel (fixed-wing pilots, helicopter pilots, and air crew) and lowest for those in armor/motor transport. Because exposure to ultraviolet radiation is the major risk factor for NMSC, personal protective measures such as wearing proper clothing, decreasing time in direct sunlight, and using sunscreen are prudent.

Non-melanoma skin cancers (NMSCs) are the most common malignancies in the U.S.[1] In most cases, NMSCs are treatable and typically have a low mortality rate; however, more than 2,000 deaths from NMSCs occur annually in the U.S.[2] One recent study estimated that 5.4 million cases of NMSC, including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), were diagnosed in 3.3 million people in the U.S. in 2012.[1] The cost for treating NMSC in the U.S. has been estimated at more than $4 billion per year.[3]

About 80% of NMSCs are BCCs with the remainder consisting mostly of SCCs.[4] The risk factors for NMSC include constitutional factors such as light skin tone and light-colored eyes and hair, and environmental factors, particularly exposure to solar ultraviolet (UV) radiation.[4] In the U.S., the epidemiology of NMSC is not well characterized, because these cancers are not tracked by most cancer registries.[5] Estimates from other sources, such as Medicare and registries outside the U.S., point to an increase in incidence in the past few decades.[1,6-7] The risk of a subsequent NMSC after an initial NMSC is high; a 10-year longitudinal study in Australia observed that nearly 50% of those who were diagnosed with a BCC developed a subsequent BCC.[8]

A previous *MSMR* article (May/June 2000) reported on the incidence of melanoma and NMSC in active component service members during 1998–1999.[9] The reported crude incidence rate based on outpatient encounters for any NMSC was 52.4 per 100,000 person-years (p-yrs). There has not been a recent update for incident diagnoses of NMSC in this population; however, there was an update for incident malignant melanoma diagnoses in the Armed Forces from January 1998 through June 2008.[10]

This report documents the number of occurrences of NMSC in the active component of the military during 2005–2014. The current study expands the 2000 *MSMR* case definition and analysis by incorporating the anatomic locations of the tumors.

METHODS

The surveillance period was 1 January 2005 through 31 December 2014. The surveillance population included all active component service members of the Army, Navy, Air Force, and Marine Corps who served at any time during the surveillance period. All data used to determine incident NMSC cases were derived from inpatient and outpatient healthcare records routinely maintained in the databases of the Defense Medical Surveillance System (DMSS).

For surveillance purposes, the defining diagnoses were in the categories of "other and unspecified malignant neoplasm of the skin" (ICD-9: 173) and "carcinoma in situ of skin" (ICD-9: 232) **(Table 1)**. A case of NMSC was defined as 1) a single hospitalization with the defining diagnoses in any diagnostic position or 2) two or more outpatient medical encounters within the same 90-day period with the defining diagnoses in any diagnostic position. For outpatient ICD-9 codes, both needed to be for the same location on the body or be a site-specific code and another code for an unspecified site. For example, an individual with two outpatient encounters for 173.0 would be classified as a case of "NMSC of the lip." An individual could also be a case of "NMSC of the lip" if the first recorded

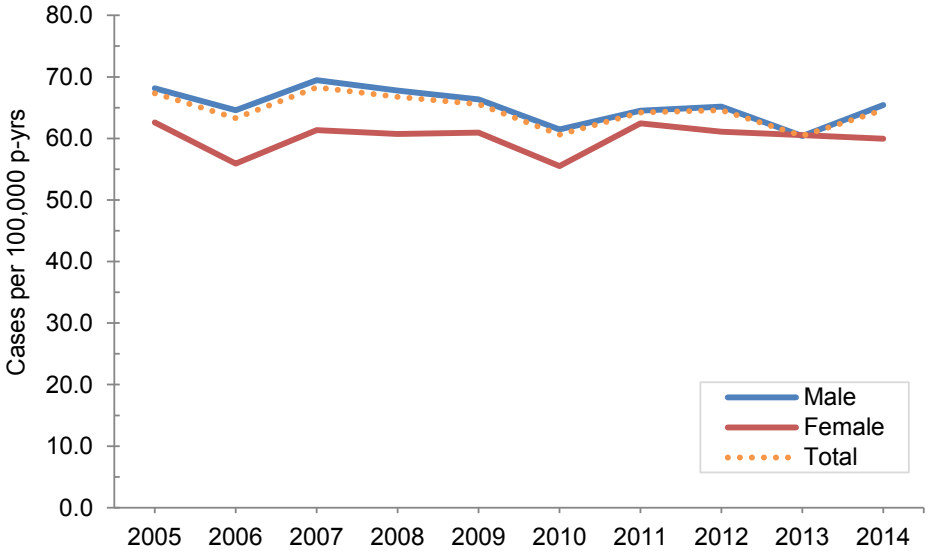
TABLE 1. ICD-9 diagnostic codes for non-melanoma skin cancers in inpatient and outpatient settings

ICD-9 code	Body region affected
173.0–173.09; 232.0	Unspecified malignant neoplasm of skin of lip; carcinoma in situ of skin of lip
173.1–173.19; 232.1	Unspecified malignant neoplasm of skin of eyelid, including canthus; carcinoma in situ of skin of eyelid, including canthus
173.2–173.29; 232.2	Unspecified malignant neoplasm of skin of ear and external auditory canal; carcinoma in situ of skin of ear and external auditory canal
173.3–173.39; 232.3	Unspecified malignant neoplasm of other and unspecified parts of face; carcinoma in situ of other and unspecified parts of face
173.4–173.49; 232.4	Unspecified malignant neoplasm of scalp and skin of neck; carcinoma in situ of scalp and skin of neck
173.5–173.59; 232.5	Unspecified malignant neoplasm of skin of trunk, except scrotum; carcinoma in situ of skin of trunk, except scrotum
173.6–173.69; 232.6	Unspecified malignant neoplasm of skin of upper limb, including shoulder; carcinoma in situ of skin of upper limb, including shoulder
173.7–173.79; 232.7	Unspecified malignant neoplasm of skin of lower limb, including hip; carcinoma in situ of skin of lower limb, including hip
173.8–173.89; 173.9–173.99; 232.8, 232.9	Unspecified malignant neoplasm of other specified sites of skin; of skin site unspecified; carcinoma in situ of other specified sites of skin; of skin site unspecified

diagnosis code of 173.0 was followed by a record of a second visit within 90 days with a code of 173.9 ("Other and unspecified malignant neoplasm of skin, site unspecified").

During the surveillance period, an individual could be counted several times as a case if tumors were coded for different body locations and the diagnoses for each location satisfied the case definition; for example, an individual could be counted as a case of NMSC of the lip and then, the following week, as a case of NMSC of the ear. An individual could also be counted multiple times for the same body location after a 365-day period of absence ("gap") of encounters for that specific body part. For example, an individual could be counted in 2006 as a case of NMSC of the lip and then counted again as a case of NMSC of the lip in 2008. Prevalent NMSC cases (i.e., cases that would have met the case definition for NMSC before the surveillance period) were not used to exclude individuals from being counted as cases during the surveillance period. The surveillance period was extended an additional 90 days to capture information on NMSC for service members with case-defining diagnoses recorded near the end of calendar year 2014.

FIGURE 1. Annual incidence rates of non-melanoma skin cancer, by sex, active component, U.S. Armed Forces, 2005–2014



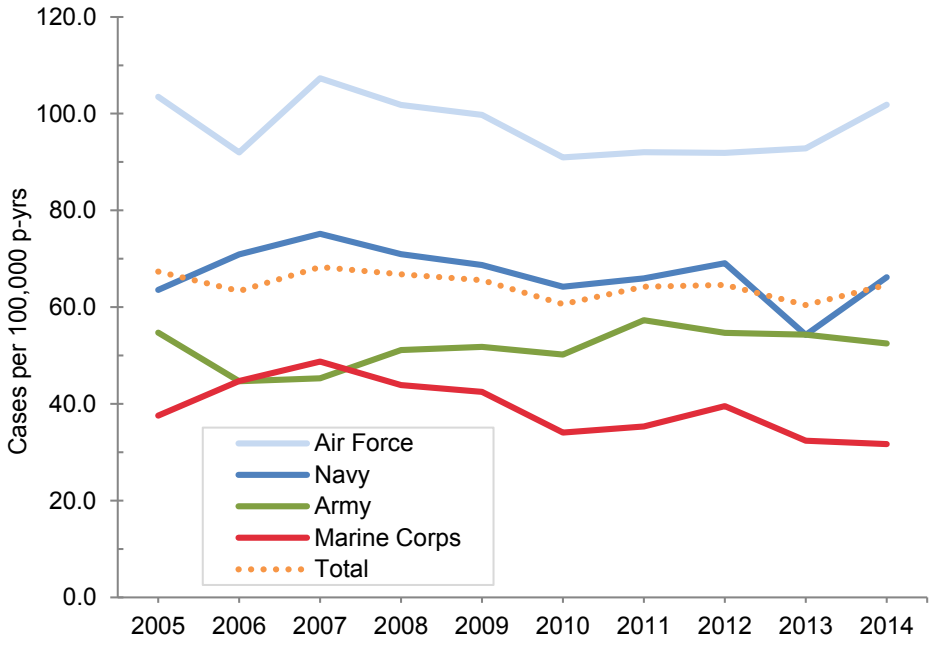
RESULTS

During the 10-year surveillance period, a total of 6,670 active component service members received 8,919 incident diagnoses of NMSC. The crude overall incidence rate was 64.6 cases per 100,000 p-yrs **(Figure 1, Table 2)**. The lowest annual incidence rate was 60.4 per 100,000 p-yrs in 2013 and the highest rate was 68.3 per 100,000 p-yrs in 2007. Overall, large changes in the annual rates were not observed; however, there was a very slight decline in the trend of annual rates over the course of the surveillance period. This slight decline was apparent for each of the military services except the Army, for which a slight increase in the trend of annual rates was observed **(Figure 2)**.

In November 2011, additional coding rules were added to ICD-9 to specify NMSC cell type as BCC, SCC, or "other" NMSC.[1] During 2012–2014, there were 2,337 incident diagnoses of NMSC; of these, 1,907 (81.6%) were BCC; 241 (10.3%) were SCC; 55 (2.4%) were carcinoma in situ of skin; and 134 (5.7%) were "other" and unspecified **(data not shown)**.

As seen in other studies on NMSC, increased rates of NMSC were associated with age, race/ethnicity, and sex **(Table 2)**. Increasing age was associated with increased rates of NMSC; those aged 40 years or

FIGURE 2. Annual incidence rates of non-melanoma skin cancer, by service, active component, U.S. Armed Forces, 2005–2014



older had a rate ratio (RR) of 255.5 compared to those younger than 20 years of age. White, non-Hispanic service members had a much higher rate of NMSC compared to black, non-Hispanic; Hispanic; and Asian/Pacific Islander service members. Female service members had slightly lower rates of NMSC compared to male service members (RR: 0.9) **(Figure 1)**. Unadjusted rates by grade were elevated for officers and higher ranks compared to enlisted and lower ranks. Crude rates by service were highest for Air Force members (97.4 per 100,000 p-yrs) and lowest for Marine Corps members (38.9 per 100,000 p-yrs). Unadjusted rates by education tended to be higher for those with more education; the rate among college-educated members was 204.0, but the rate for those with high school education only was 24.3 per 100,000 p-yrs. By military occupation, crude rates were highest for those associated with air travel (279.2 per 100,000 p-yrs for fixed-wing pilots, 197.3 per 100,000 p-yrs for helicopter pilots, and 150.4 per 100,000 p-yrs for air crew) and lowest for those in armor/motor transport (28.9 per 100,000 p-yrs) **(Table 2)**.

Recording of anatomic location was incomplete as only 80.5% of cases had records that noted a specific anatomic location **(Table 3)**. Among the NMSC records that noted specific anatomic sites, 68.9% of NMSCs were coded as occurring on locations on the face, head, or neck. Of all cases of NMSC, 55.5% were documented as located on the face, head, or neck.

EDITORIAL COMMENT

This report documents an incidence of NMSC among active component service members that is relatively high compared to other cancers. On average, during 2005–2014, there were 64.6 incident NMSC diagnoses per 100,000 p-yrs. In comparison, during the same time period, the combined, total incidence rate of the following 16 types of cancer together (malignant melanoma, colon and rectum, lung/bronchus, brain/other central nervous system, non-Hodgkin lymphoma, leukemia, female breast, cervix, prostate, testis, bladder, kidney, liver, pancreas, stomach, and ovary) was 63.4 cases per 100,000 service members per year.[11] This observation is consistent with studies of civilian populations that have estimated that the number of NMSCs surpasses the number of all other cancers combined.[1,12]

During the 10-year surveillance period, there was a very slight decrease in the annual crude incidence rates of NMSC; rates of NMSC peaked in 2007 (68.3 cases per 100,000 p-yrs) and were at their lowest in 2013 (60.4 cases per 100,000 p-yrs). In contrast, sparse comparative civilian data suggest an increase in NMSC rates over time.[1,6-7] There have been several theories advanced to explain the rate increases, including increased surveillance efforts, aging of the population, and changes in tanning practices.[4]

The effects of well-established demographic risk factors on NMSC incidence are clearly seen in the results of this analysis as the highest rates were observed in older, white, non-Hispanic, and male service members. The elevated crude rates observed for higher pay grades most likely reflect the increased incidence associated with older age. This analysis also found higher crude rates for Air Force members, those with higher levels of educational attainment, and those in aviation-related occupational groups. These crude rate differences may have been due, at least in part, to differences in the demographic factors of age, race/ethnicity, and sex, although the observation of higher rates for aviation-related occupational groups is noteworthy. Observed differences in incidence rates of NMSC by occupational category warrant further analysis to examine adjusted (e.g., by age, sex, race/ethnicity) incidence rates among service members within these categories.

Although NMSCs are the most common cancers in the world, the epidemiologic patterns are not as well documented as other cancers because many cancer registries, including the Surveillance, Epidemiology, and End Results (SEER) program at the National Cancer Institute, do not record NMSC. However, there are well-established risk factors for NMSC; in particular, solar UV radiation is well accepted as a risk factor as evidenced by observed patterns or the anatomic distributions of NMSCs, higher rates by latitude, higher rates for those with lighter skin, and the findings from migration studies.[4]

Manner of exposure to solar UV radiation differentially affects the types of NMSC. SCC is associated with chronic

TABLE 2. Counts and incidence rates of non-melanoma skin cancer diagnoses, by demographic characteristics, active component, U.S. Armed Forces, 2005–2014

	Total Jan 2005–Dec 2014		
	No.	Rate[a]	RR
Total	8,919	64.6	.
Service			
Army	2,732	51.7	ref
Navy	2,203	66.9	1.3
Air Force	3,236	97.4	1.9
Marine Corps	748	38.9	0.8
Sex			
Male	7,711	65.3	ref
Female	1,208	60.2	0.9
Race/ethnicity			
White, non-Hispanic	8,237	96.5	ref
Black, non-Hispanic	115	5.1	0.1
Hispanic	225	14.0	0.1
Asian/Pacific Islander	53	10.0	0.1
Other	289	32.7	0.3
Age			
<20	13	1.5	ref
20–24	213	4.7	3.3
25–29	554	17.1	11.8
30–34	958	46.3	31.9
35–39	1,741	107.2	73.9
40+	5,440	370.7	255.5
Military occupation			
Combat	883	46.5	ref
Armor/motor transport	154	28.9	0.6
Fixed-wing pilot	536	279.2	6.0
Helicopter pilot	279	197.3	4.2
Air crew	285	150.4	3.2
Repair/engineering	1,908	47.7	1.0
Communications/intelligence	1,770	57.4	1.2
Health care	1,268	107.5	2.3
Other	1,836	70.8	1.5
Rank			
Jr. enlisted (E1–E4)	443	7.4	ref
Sr. enlisted (E5–E9)	3,545	64.6	8.8
Jr. officer (O1–O3, W1–W3)	982	69.7	9.5
Sr. officer (O4–O9, W4–W5)	3,949	438.4	59.6
Education			
Less than high school	29	41.4	1.7
High school	2,329	24.3	ref
Some college	1,158	88.6	3.6
College	5,162	204.0	8.4
Other	241	73.7	3.0

RR, rate ratio

[a]Rate per 100,000 person-years

lifetime solar exposure, whereas BCC is associated with a combination of chronic lifetime exposure and acute intense exposure. Data suggest that intense exposure during childhood or teenage years is a risk factor for BCC and melanoma.[4] Other risk factors for NMSC include immunosuppression, exposure to inorganic arsenic, use of photosensitizing drugs, and occupational exposures (such as tar, soot, asphalt, crude paraffin, anthracene, pitch solvents, and mineral oils).[13] Exposure to ionizing radiation is a risk factor for both SCC and BCC; however, for SCC, the effect is seen only at high doses (e.g., greater than 2 Gray).[4] Evidence for the association between ionizing radiation and BCC comes from analyses of data from Japanese atomic bomb survivors, occupational studies (e.g., medical x-ray technologists, nuclear workers), and studies of patients treated with therapeutic radiation.[14-16] Associations between frequent air travel and higher rates of skin cancer, in particular melanoma and BCC, have been observed; however, the association has not been consistent.[17-18] At higher altitudes, exposure to cosmic radiation, which is ionizing, is greater than at ground level. The observation that rates of NMSC were higher in occupational groups associated with air travel supports the hypothesis of an association between air travel and skin cancer.

More than 50% of NMSC tumors were observed on locations on face, neck, or other parts of the head. This finding is in agreement with clinical observations; however, because of the lack of NMSC inclusion in many cancer registries, the data summarized here are relatively unique. Specifically, these data are one of the few sources of population-based data that document the anatomic locations of NMSCs. Other sources of anatomic location information using population-based data include reports from New Mexico, New Hampshire, and Australia.[4,8]

Because there are no established methods for ascertainment of NMSC cases using administrative data, there is uncertainty in the estimates of the incidence of NMSC cases reported here.[19] The case definition used in this study required two outpatient encounters within a 90-day period; the encounters were required to be in the same anatomic location or a specific anatomic location and an "unknown" anatomic

TABLE 3. Incident and recurrent cases of non-melanoma skin cancer, by anatomic location, active component, U.S. Armed Forces, 2005–2014

		Total Jan 2005–Dec2014		
ICD-9 code	Anatomic location	No.	%	Rate[a]
x.0x	Unspecified malignant neoplasm of skin of lip	153	1.7	1.1
x.1x	Eyelid, including canthus	264	3.0	1.9
x.2x	Ear and external auditory canal	349	3.9	2.5
x.3x	Other and unspecified parts of face	3,182	35.7	23.0
x.4x	Scalp and skin of neck	999	11.2	7.2
x.5x	Trunk, except scrotum	1,272	14.3	9.2
x.6x	Upper limb, including shoulder	708	7.9	5.1
x.7x	Lower limb, including hip	254	2.8	1.8
x.8x/x.9x	Other specified sites of skin; site unspecified	1,738	19.5	12.6
Total		8,919	100.0	64.6

[a]Rate per 100,000 person-years

location. It was assumed that the tumor in the "unknown" anatomic location was the same tumor referenced in the other encounter. This tumor could be a different tumor in a different location or this tumor could also be a different new tumor, but in a different location within the same anatomic area; over- or undercounting are both possible.

Exposure to UV radiation is the major risk factor for NMSC. Prudent preventive measures for decreasing exposure to solar UV radiation include wearing protective clothing, avoiding sun exposure during peak hours, and using sunscreen. The use of tanning beds can be a significant source of UV radiation, so their use is generally discouraged. Those at high risk for skin cancer, such as those who have prolonged or intense exposure to UV radiation or those with host risk factors, should be aware of the signs of tumor development. Although those with host risk factors such as light skin are at higher risk for skin cancer, skin cancer can develop in all ethnicities and skin types. General guidance can be found from online resources such as the Army Public Health Center and The Skin Cancer Foundation.[20-22]

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Zika Virus Infections in Military Health System Beneficiaries Since the Introduction of the Virus in the Western Hemisphere, 1 January 2016 Through 30 November 2016

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The introduction and rapid spread of Zika virus (ZIKV) across the Western Hemisphere have posed a risk of infection to Military Health System (MHS) beneficiaries. The associated consequences of infection and the dynamics of transmission may place a unique burden on military personnel, their dependents, and the MHS. This article summarizes the impact of ZIKV transmission on MHS beneficiaries between 1 January and 30 November 2016. Cases were identified from a variety of sources, including direct reporting from the services, extraction of laboratory data, and data from the Defense Medical Surveillance System (DMSS) Reportable Medical Events database. There have been 156 confirmed cases of Zika in MHS beneficiaries, including five Zika cases in pregnant beneficiaries and 110 cases in service members. A majority of cases reported exposure in Puerto Rico (n=91, 58.3%). Although most ZIKV infections are asymptomatic or have a relatively mild illness, the gravity of pregnancy and neurologic issues linked to infection remains a significant impetus for the continued surveillance of ZIKV in the MHS population.

The introduction of Zika virus (ZIKV) into the Western Hemisphere in Brazil in early 2015 and its subsequent spread to nearly 50 countries and territories within a 17-month period posed a potential risk of infection to Military Health System (MHS) beneficiaries. Although the acute and mild symptoms associated with infection are not a major operational threat, the associated fetal malformations, potentially associated neurologic disorders, and the dynamics of ZIKV transmission can place a unique burden on military personnel, their dependents, and the MHS. This article summarizes the impact that ZIKV transmission in the Western Hemisphere has had on MHS beneficiaries since its introduction in early 2015.

ZIKV is a *Flavivirus* of the *Flaviviridae* family related to dengue, yellow fever, and West Nile virus. Primary transmission of ZIKV to humans occurs through the bite of an infected *Aedes* mosquito (*Ae. aegypti* or *Ae. albopictus*); however, sexual transmission and transmission through other bodily fluids have been confirmed. Approximately one out of five individuals infected with ZIKV will develop symptoms, including fever, skin rash, conjunctivitis, muscle and joint pain, malaise, and headache. [1] These symptoms are similar to those of dengue, chikungunya, and other arboviral infections. The time from infection to presentation with clinical symptoms (incubation period) is currently unknown; however, symptom onset is suspected to occur no more than a few days after exposure to the virus.[1] Illness duration is typically 2–7 days after illness onset. In the absence of comorbidities, fatalities due to ZIKV infection are rare, and lifetime immunity is believed to have been acquired after infection.

A small proportion of individuals who became symptomatic have developed Guillain-Barré syndrome (GBS), a rare illness that causes the immune system to damage nerve cells, resulting in muscle weakness and paralysis in some cases.[2] According to the U.S. Centers for Disease Control and Prevention (CDC), research suggests a strong association between Zika and GBS, but the link continues to be investigated.[2]

ZIKV RNA has been detected in multiple bodily fluids of human cases for varying periods of time after symptom onset, including urine (up to 91 days), saliva (up to 91 days), vaginal secretions (up to 14 days), and semen (up to 188 days).[3,4] Virus has also been detected in the eyes and tears of ZIKV-infected laboratory mice.[5] Although the detection of viral RNA does not necessarily equate to the presence of infectious live virus, these findings support the continued concern regarding non-vector transmission of ZIKV. The persistence of the virus in semen and its subsequent effect on developing fetuses distinguish the risk associated with Zika from the risks associated with dengue and chikungunya.

ZIKV was first isolated in a captive rhesus monkey in Uganda in 1947 during routine yellow fever surveillance, and the first human cases of Zika were reported in 1952 in Uganda and Tanzania.[1] After its discovery in humans, cases continued to be reported sporadically with outbreaks recorded in tropical Africa, Southeast Asia, and eventually the Pacific Islands. In 2007, the first large-scale outbreak of Zika was reported on Yap Island in the Federated States of Micronesia.[1] Between 2013 and 2014, outbreaks occurred on four other Pacific Islands, leading to its introduction to the Western Hemisphere in 2015.

Before its explosive spread in the Western Hemisphere, Zika was characterized as a relatively inconsequential mild febrile illness; however, after its widespread introduction into immunologically

naïve populations, a correlation with the rising numbers of cases of microcephaly, other congenital malformations, and GBS became evident. Retrospective studies of the French Polynesia outbreak found causal evidence supporting a link between infection during pregnancy and resulting microcephaly in fetuses and neonates as well as a link between ZIKV infection and GBS.[6,7] On 1 February 2016, after reviewing evidence from Brazil and French Polynesia, the World Health Organization (WHO) declared the clusters of microcephaly cases and other neurologic conditions, including GBS, a Public Health Emergency of International Concern (PHEIC).[8] On 18 November 2016, following the fifth meeting of the Emergency Committee (EC) on ZIKV, microcephaly, and other neurologic disorders, WHO announced that the event no longer met the criteria for a PHEIC.[9] The EC further stated that ZIKV and its associated consequences remain a significant enduring public health challenge requiring intense action.[9]

In April 2016, a study published by the CDC established a causal relationship between ZIKV infection in expectant mothers and microcephaly and other fetal brain defects.[10] As of 1 December 2016, a total of 28 countries had reported cases of microcephaly and other fetal malformations potentially associated with ZIKV, including four countries reporting malformation cases from travel-related ZIKV infections.[11] The CDC has reported 33 pregnancy losses or infants with birth defects among pregnancies with evidence of possible ZIKV infection in U.S. states; Puerto Rico has reported five cases of congenital defects related to ZIKV infection.[12,13]

Since the introduction of ZIKV into the Western Hemisphere in 2015, a total of 20 countries and territories have reported GBS cases associated with ZIKV infection, including Puerto Rico and the U.S.[11] Puerto Rico has reported a total of 62 cases of GBS, of which 46 are related to Zika and 16 are classified as associated with *Flavivirus* not otherwise specified. The CDC has recorded 13 cases of ZIKV-related GBS in U.S. states as of 23 November.[12,14]

Outside the Western Hemisphere, 23 countries and territories in the Asia-Pacific region and three in West Africa have been categorized as having had local transmission prior to 2015, evidence of vector-borne transmission in 2016, or possible endemic transmission.[11] Of these countries, five have reported microcephaly and/or central nervous system malformation cases potentially associated with ZIKV infection.[11] French Polynesia is the only location outside the Western Hemisphere that has recorded an increase in incidence of GBS cases or GBS cases with confirmed ZIKV infection.[11]

As of 23 November 2016, CDC's ArboNET had recorded 4,261 travel-associated Zika cases in U.S. states, including 36 sexually transmitted cases.[14] Local transmission in 2016 has been confirmed in three U.S. territories: Puerto Rico (34,562 cases; as of 10 November), U.S. Virgin Islands (808 cases; as of 29 November), and American Samoa (54 cases; as of 23 November).[12,14,15] Within the continental U.S., local vector transmission of ZIKV in 2016 has been confirmed in Miami-Dade County, FL, (244 cases; as of 30 November) and Cameron County, TX (one case; as of 30 November).[16,17] With more than 3,500 Zika cases reported to the U.S. Zika Pregnancy Registry, Zika continues to be a significant public health concern.[18]

METHODS

The study population consisted of all MHS beneficiaries with confirmed ZIKV infection reported between 1 January 2016 and 30 November 2016. Cases were identified through: direct contact with the services and the CDC to capture cases seeking care outside of a DoD medical treatment facility, the Defense Medical Surveillance System (DMSS) Reportable Medical Events (RME) database, daily and weekly RME reports by the services, and the Navy and Marine Corps Public Health Center's laboratory test results database. Zika is not an RME; therefore, cases were reported as "Any Other Unusual Condition Not Listed," with "Zika" entered in the comment field, as described in the Armed Forces Health Surveillance Branch's (AFHSB's) detection and reporting guidance for Zika. Additional information, such as travel history and pregnancy status, was also included in the comment field. Areas with ongoing local transmission of ZIKV were recorded as locations of likely exposure to the virus.

A confirmed Zika case was defined as having had either a positive real-time reverse transcription polymerase chain reaction test of the patient's serum or urine or a presumptive positive IgM test result with a positive confirmatory plaque reduction neutralization test, as defined by CDC laboratory guidance.[19] Most cases were symptomatic; however, laboratory-confirmed asymptomatic cases were included in the study population. Presumptive positive Zika cases and cases of non-specific *Flavivirus* infections were not included in the study population. Once confirmed, demographic data and information such as symptom onset data, pregnancy status, and location of potential exposure were collected. Location of potential ZIKV exposure included all countries and territories traveled to with ongoing ZIKV transmission or possible endemic transmission that were reported by the infected person. These details were extracted from the notes in the comment field of the RME data set or reported to AFHSB by the services.

RESULTS

Between 1 January 2016 and 30 November 2016, a total of 156 confirmed Zika cases were reported in MHS beneficiaries. Of these, 110 (70.5%) cases were service members, of whom 90 (81.8%) were in the active component and 20 (18.2%) were in the reserve component. Military retirees accounted for 11 (7.1%) cases, and 35 (22.4%) cases were reported among all other beneficiaries of MHS health care.

A majority of MHS beneficiary cases were between 21 and 45 years of age (61.5%), and more than 60% of the affected population were male (n=94). See **Table 1** for a summary of case demographic information.

Among affected service members, the Army reported the most Zika cases with 48 confirmed (43.6%), followed by the Coast Guard (n=29, 26.4%). The Navy and Marine Corps reported the lowest numbers of confirmed Zika infections

TABLE 1. Age and gender distribution of Zika cases in service members and other Military Health System (MHS) beneficiaries diagnosed between 1 January 2016 and 30 November 2016

	Service members[a]	Other MHS beneficiaries[b]	Total	(%)
Age group (years)				
0–20	2	9	11	7.1%
21–25	17	3	20	12.8%
26–30	22	4	26	16.7%
31–35	24	5	29	18.6%
36–40	19	2	21	13.5%
41–45	8	3	11	7.1%
46–50	10	3	13	8.3%
51–55	5	4	9	5.8%
56+	0	8	8	5.1%
Not reported	3	5	8	5.1%
Sex				
Female	30	32	62	39.7%
Male	80	14	94	60.3%

[a]Includes both active and reserve components.

[b]Includes retirees, dependents, and other MHS beneficiaries.

in military personnel, together accounting for less than one-fifth of the 110 cases in service members **(Table 2)**. Overall, the highest percentage of ZIKV infections in military personnel was reported in males (n=80, 72.7%), and approximately three-quarters of the cases were between 21 and 40 years of age, as would be expected in this population.

Five confirmed Zika cases have been reported among pregnant MHS beneficiaries, including four service members and one dependent. There have been no cases of GBS reported in any of the confirmed Zika cases.

Of the total of 156 confirmed cases, two were asymptomatic, and 154 were symptomatic. Of the symptomatic cases, symptom details were available for 110 cases (71.4%). For the remaining 44 symptomatic cases, data beyond symptomatic status were not available. Conjunctivitis, fatigue, arthralgia, fever, and rash are among the major hallmark symptoms of ZIKV infection. A majority of the cases for whom symptom details were provided reported two (n=22), three (n=36), or four (n=37) of these symptoms. The most commonly noted symptoms were rash (n=98), fever (n=85), and arthralgia (n=82). Fatigue and conjunctivitis were reported in approximately half as many cases as the previous three symptoms **(data not shown)**.

TABLE 2. Military service and component of Zika cases in service members diagnosed between 1 January 2016 and 30 November 2016

	Active component	Reserve component	Total
Service			
Air Force	16	0	16
Army	31	17	48
Coast Guard	28	1	29
Marine Corps	7	0	7
Navy	8	2	10
Total	90	20	110

Table 3 summarizes the probable regions of ZIKV exposure of all confirmed Zika cases. Four cases reported travel to two or more regions with ongoing ZIKV transmission. Likely exposure in the continental U.S. was reported for one service member. All other cases were acquired outside of the continental U.S., with a majority of cases reporting exposure in Puerto Rico (n=91). In the Western Hemisphere, 27 countries and territories, including the continental U.S., were likely locations of exposure for MHS beneficiary cases. Six countries in Southeast Asia were cited as areas of potential ZIKV exposure. The travel histories of three confirmed cases were not reported (1.9%).

The **Figure** illustrates the epidemiologic curve of confirmed Zika cases in MHS beneficiaries from 1 January 2016 through 30 November 2016 based on dates of illness onset. If symptom onset date was not available, the date of clinical visit, date of specimen collection, date tested positive, or date reported to the AFHSB was used (listed in order of priority). Illness onset dates were available for 121 cases (77.5%). For the remaining 35 cases, date of clinical visit was available for 31 cases; date tested positive was used for one case; and date reported to AFHSB was utilized for three cases. More than three-fourths of the cases (n=122) experienced illness onset between June 2016 (epidemiologic week [EW] 22) and September 2016 (EW 37), with 75 of those cases reporting likely exposure in Puerto Rico.

The first MHS beneficiary case experienced symptom onset in January 2016. Following this initial case, confirmed cases continued to be reported sporadically until May 2016. Beginning in May 2016 (EW 17), case incidence steadily increased, reaching its peak at the end of July 2016 (EW 30). Incidence then began to decline and proceeded to be more sporadic in nature between the end of October 2016 and 30 November 2016.

TABLE 3. Reported geographic regions of potential exposure of Zika cases in service members and other Military Health System (MHS) beneficiaries diagnosed between 1 January 2016 and 30 November 2016

	Service members[a]	Other MHS beneficiaries[b]	Total[c]
Region of exposure			
Asia	2	1	3
Caribbean	26	15	41
Central America and Mexico	8	7	15
South America	5	1	6
Puerto Rico	68	23	91
U.S. (Florida)	1	0	1
Unknown	2	1	3
Total[c]	112	48	160

[a]Includes both active and reserve components.

[b]Includes retirees, dependents, and other MHS beneficiaries.

[c]Some cases reported travel in more than one region with ongoing ZIKV transmission.

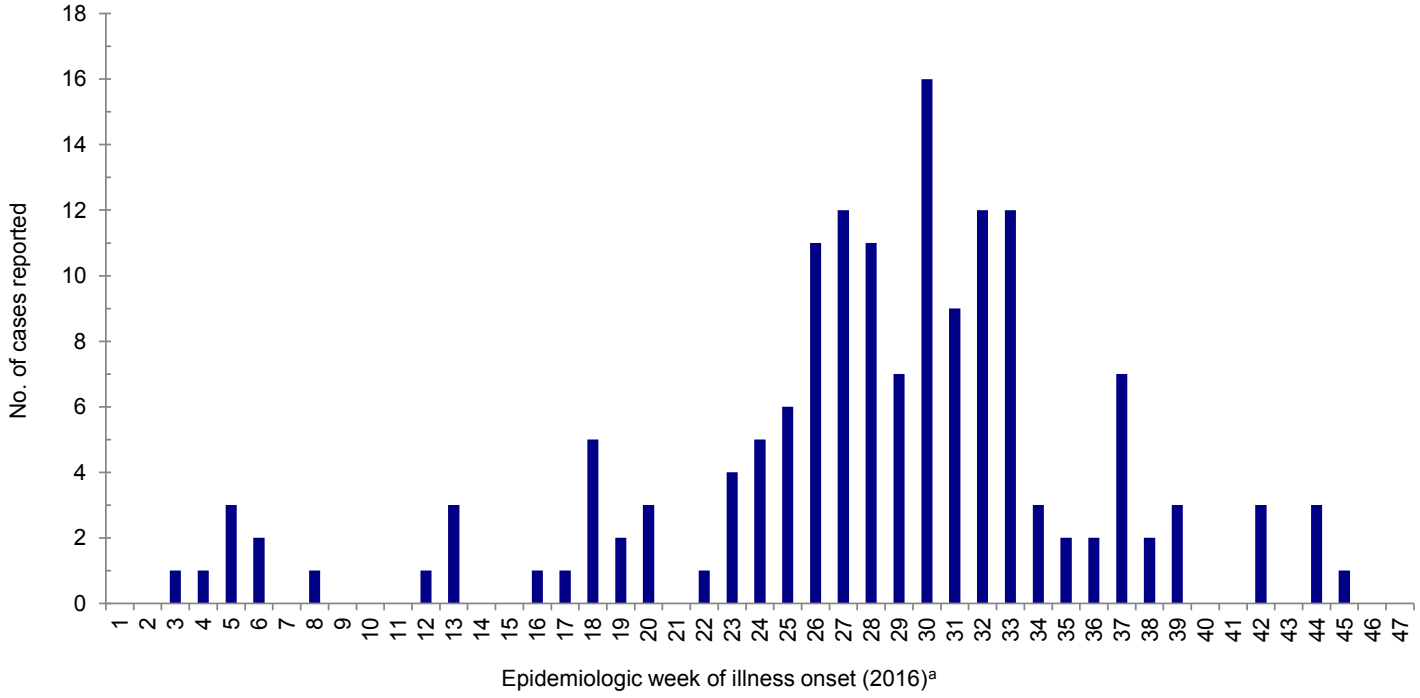
EDITORIAL COMMENT

In February 2016, AFHSB published guidance regarding the detection and reporting of Zika cases in MHS beneficiaries, which has since been revised to reflect changes in the laboratory and clinical guidance provided by the CDC. Zika has not yet been added as a mandatory RME in the DoD; however, emphasis has been placed on the detection and reporting of cases through the Disease Reporting System internet.

Given the asymptomatic nature of the large majority of ZIKV infections, the number of cases in MHS beneficiaries reported here is likely to be a significant underestimate. The true burden of disease would be difficult to assess in the absence of active surveillance of all beneficiaries traveling to or living in an area with ongoing ZIKV transmission. The co-circulation of related arboviruses in the U.S. Africa Command, U.S. Southern Command, and U.S. Pacific Command areas of responsibility and the U.S. territories poses an additional challenge to accurately identifying incident cases with current diagnostic tools.

Overall, incidence in Puerto Rico and the number of travel-related cases being reported in U.S. states have been declining. This trend has also been seen in most of the Caribbean, and North, Central, and South America since October 2016.[20] Estimation of circulation of ZIKV in Southeast Asia and the Pacific Islands is difficult to assess without systematic active testing and surveillance for the disease. Sporadic transmission of ZIKV in countries and territories in the Asia-Pacific region is expected; previous evidence of local transmission has indicated that ZIKV is endemic or potentially endemic to at least 11 countries in that area.[21]

FIGURE. Epidemiologic curve of confirmed Zika cases in Military Health System beneficiaries (N=156) diagnosed between 1 January 2016 and 30 November 2016, by date of illness onset



[a]If illness onset date was not available, date of clinical visit/specimen collection, date tested positive, or date reported was used.

Although most ZIKV infections are asymptomatic or have a relatively mild illness, the gravity of pregnancy and neurologic issues linked to infection remains a significant impetus for the continued surveillance of ZIKV in the MHS population.

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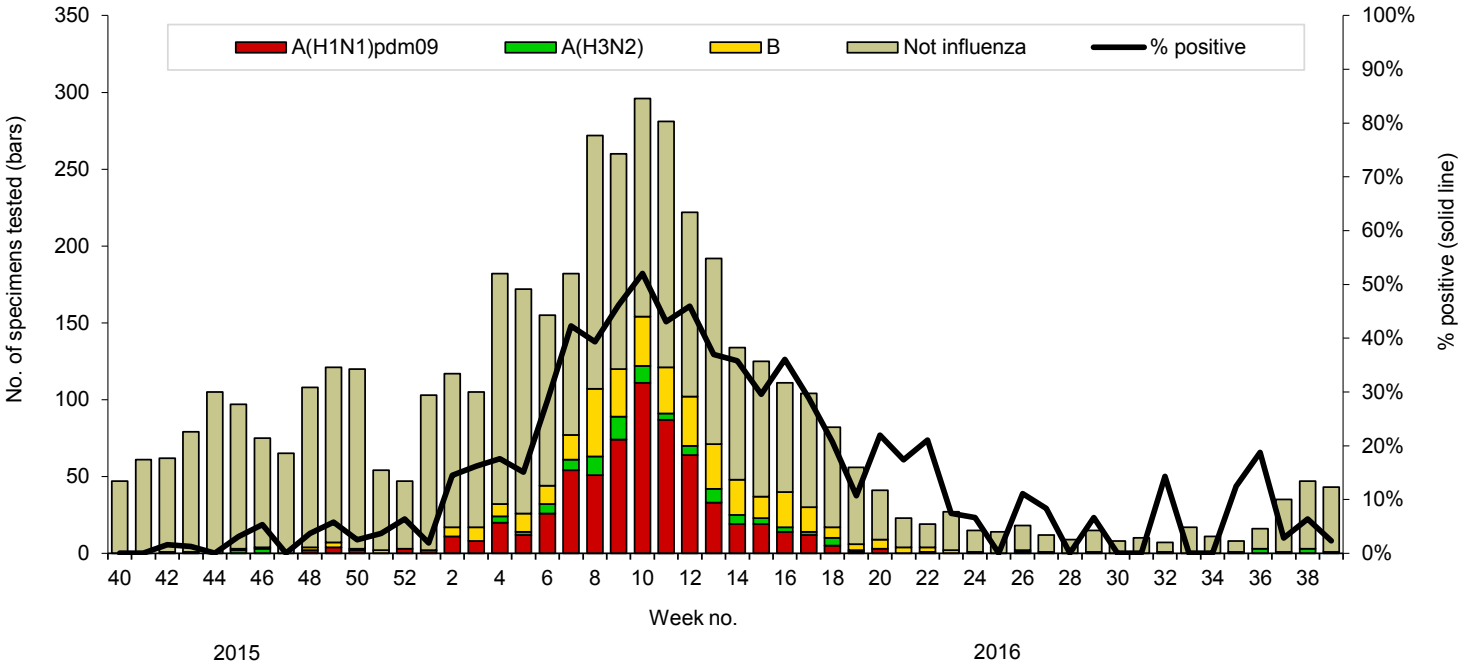
Surveillance Snapshot: Findings from the Department of Defense Global, Laboratory-based, Influenza Surveillance Program, 2015–2016 Influenza Season

Lisa A. Shoubaki, MPH

FIGURE. Numbers and percentages of respiratory specimens positive for influenza viruses, and numbers of influenza viruses identified, by type, by surveillance week, Department of Defense healthcare beneficiaries, 2015–2016 influenza season



Program description

The Department of Defense (DoD) Global, Laboratory-Based, Influenza Surveillance Program monitors the circulation of influenza viruses throughout each influenza season. Each season runs from the beginning of October through the end of the next September. The sentinel site program, which has 95 worldwide sites, contributes to the overall health of DoD beneficiaries by identifying new and circulating viruses, evaluating influenza vaccine effectiveness, and sharing data and specimens with the Centers for Disease Control and Prevention to help select virus strains for the next year's influenza vaccine. Respiratory specimens are collected at military treatment facilities from patients who present with influenza-like illness (ILI), which is defined as the presence of fever (>100.5°F) and either cough or sore throat within 72 hours of symptom onset. The U.S. Air Force School of Aerospace Medicine Epidemiology Laboratory tests all respiratory specimens through a reverse transcription polymerase chain reaction (RT-PCR) detection test and culture for confirmatory results. For patients who meet the ILI case definition but whose specimens test negative for influenza on RT-PCR, their specimens may also be tested for other respiratory pathogens through a multiplex respiratory panel.

Trends

During the 2015–2016 influenza season, a total of 4,591 specimens were tested from 80 locations. Of those submitted for routine surveillance, 755 (16.5%) tested positive for influenza A; 377 (8.2%) tested positive for influenza B; 1,182 (25.7%) tested positive for other respiratory pathogens; and 2,277 (49.6%) tested negative. The predominant influenza strain was A(H1N1)pdm09. Peak influenza activity occurred during weeks 7–13 (14 February–2 April 2016). The peak week for A(H1N1)pdm09 was week 10 and the peak weeks for influenza B were weeks 8 and 12.

Author affiliations: STS Systems Integration (SSI), LLC; Air Force Satellite Cell of the Armed Forces Health Surveillance Branch, Defense Health Agency, Wright-Patterson Air Force Base, OH.

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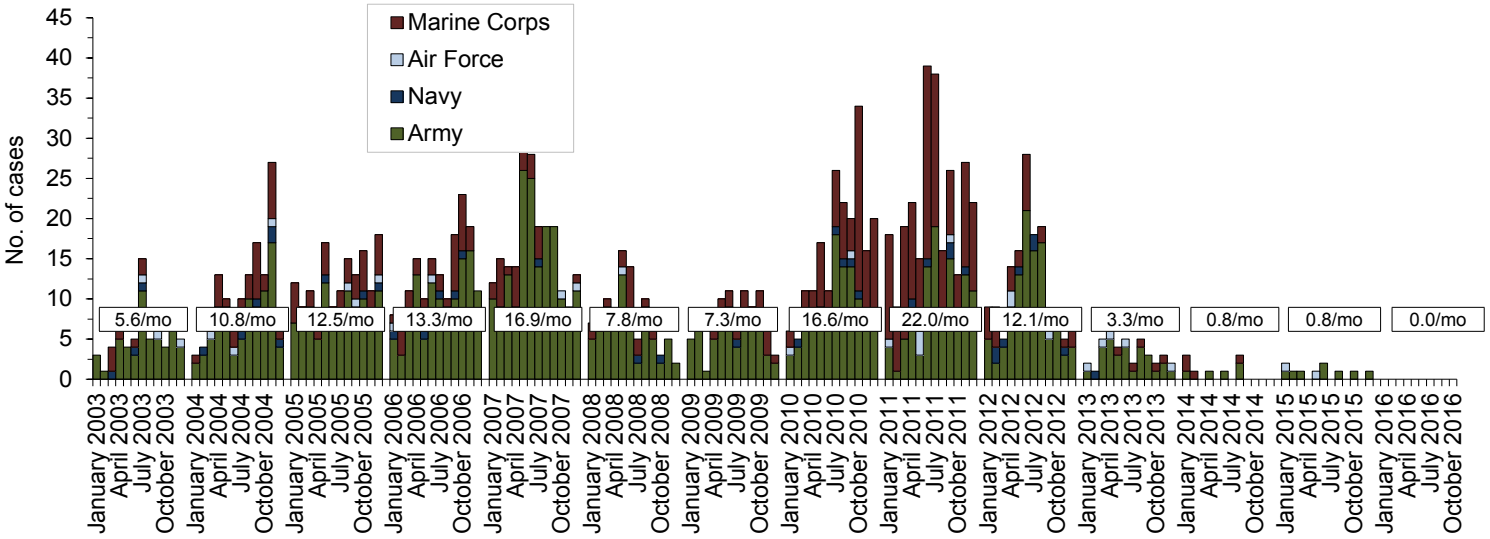
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2016 (data as of 22 November 2016)

Amputations[a,b]

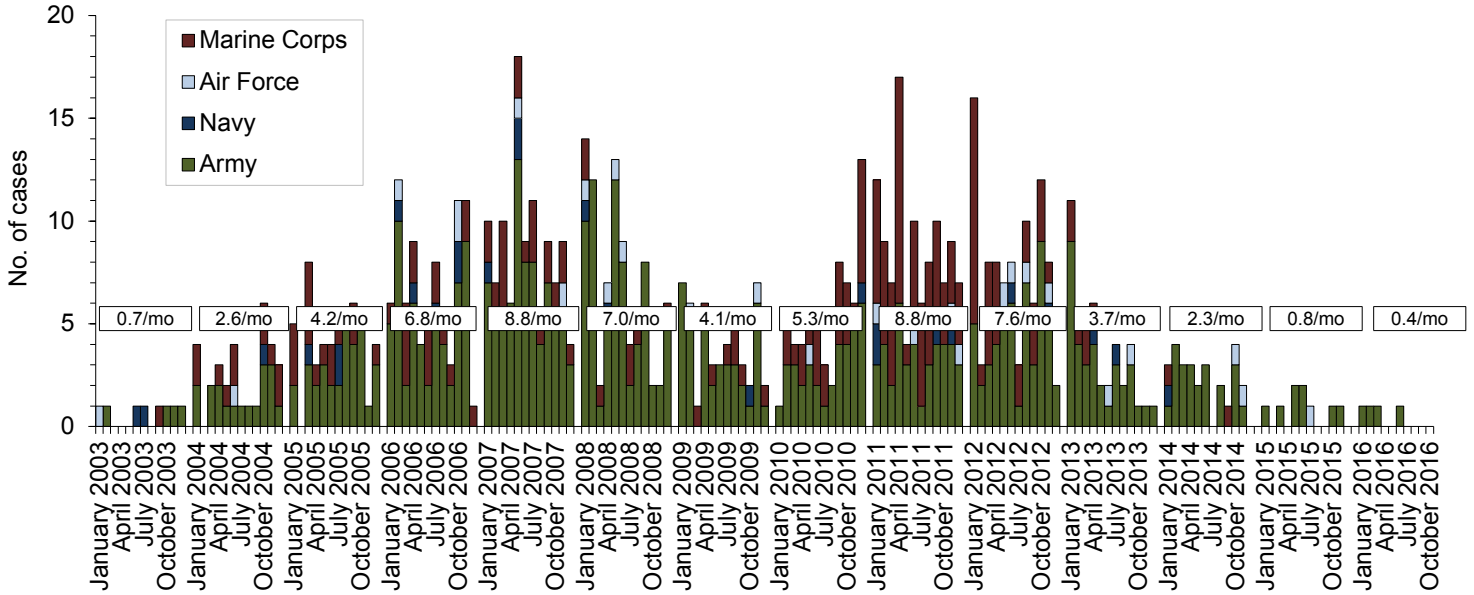


Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990–2004. *MSMR*. 2005;11(1):2–6.

[a]Amputations (ICD-10: S48, S58, S684, S687, S78, S88, S980, S983, S989, Z440, Z441, Z4781, Z891, Z892, Z8943, Z8944, Z895, Z896, Z899)

[b]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from deployment.

Heterotopic ossification[a,b]



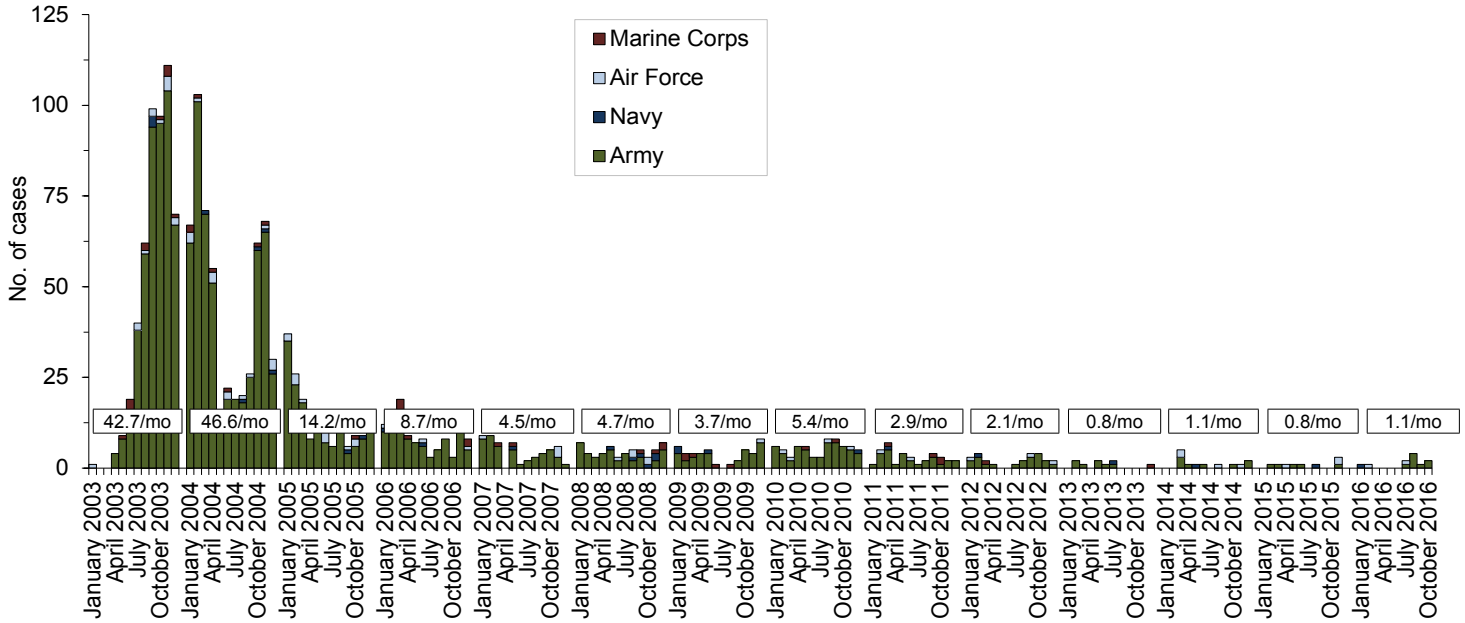
Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002–2007. *MSMR*. 2007;14(5):7–9.

[a]Heterotopic ossification (ICD-10: M610, M614, M615)

[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from deployment.

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2016 (data as of 22 November 2016)

Leishmaniasis[a,b]

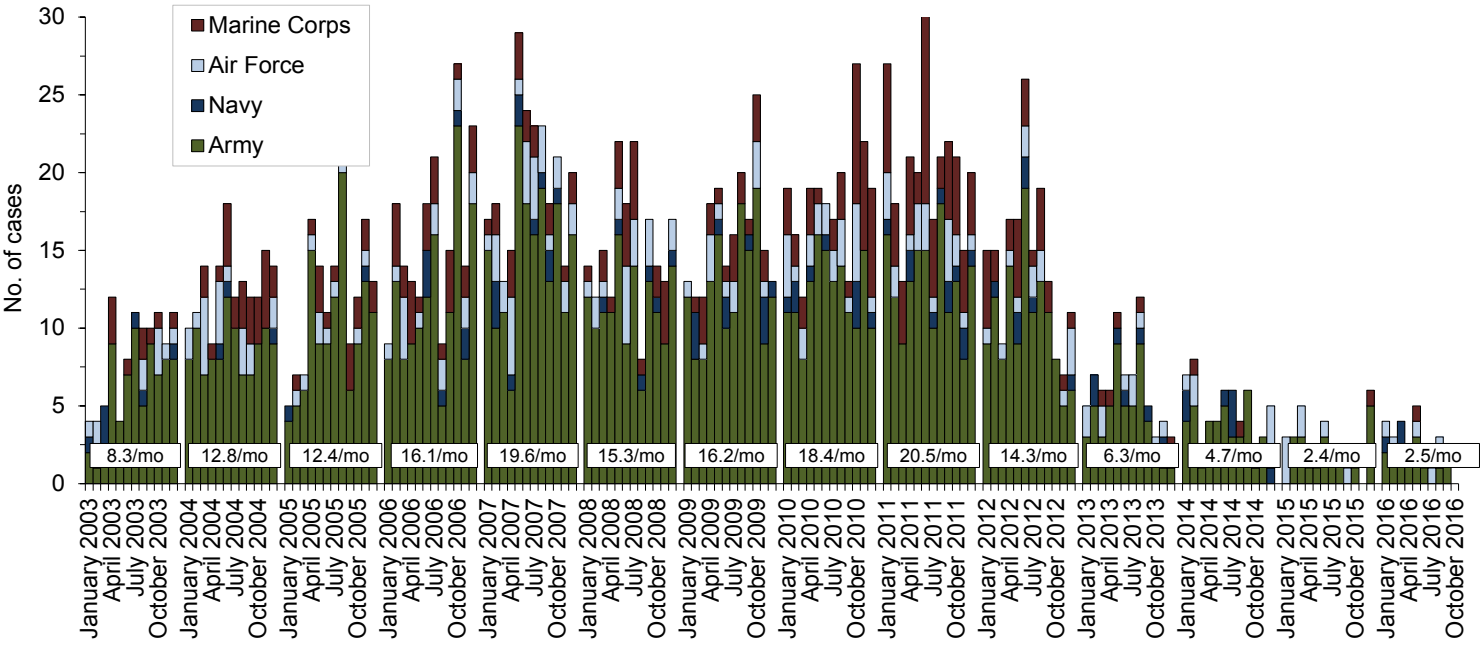


Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. *MSMR*. 2004;10(6):2–4.

[a]Leishmaniasis (ICD-10: B55, B550, B551, B552, B559)

[b]Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during or after service in OEF/OIF/OND.

Deep vein thrombophlebitis/pulmonary embolus[a,b]



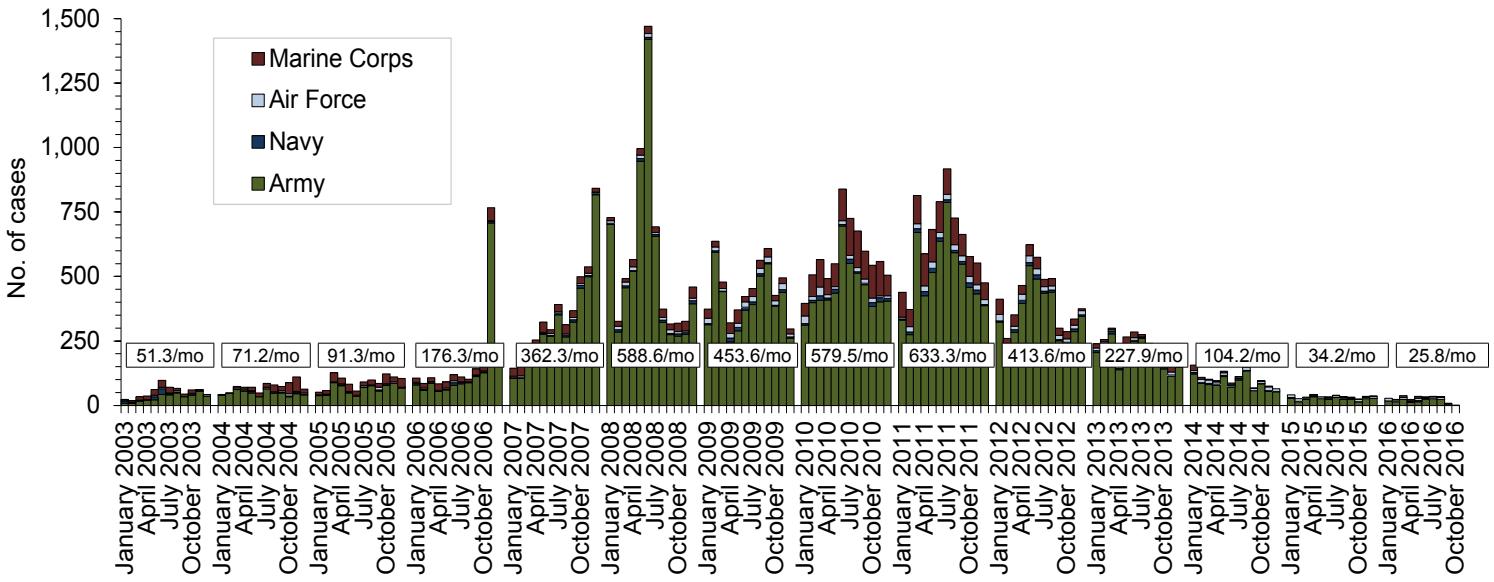
Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379–383.

[a]Deep vein thrombophlebitis/pulmonary embolus (ICD-10: I2601, I2609, I2690, I2699, I801–I803, I808, I809, I822–I824, I826, I82A1, I82B1, I82C1, I8281, I82890, I8290)

[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from deployment.

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2016 (data as of 22 November 2016)

Traumatic brain injury (TBI)[a,b]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. 2009;16(12):2–8.

[a]For the complete list of ICD-10 codes used here for TBI, see p. 23 of the May 2016 issue of the *MSMR*.

[b]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from deployment (includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 4,750 deployers who had at least one TBI-related medical encounter any time prior to deployment).

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